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64 Blends of egg albumen and whey protein of improved gel strength.

57 A dried blend of egg albumen and whey protein-containing composition which exhibits improved gel strength is prepared by subjecting desugared dried pasteurized egg albumen to a heat treatment for a period of time which is in excess of 2 to 8 weeks more than the time for which the egg albumen was subjected to dry pasteurization above 55°C., the period of time being sufficient to elevate the gel strength of the egg albumen to more than 250 grams in excess of the gel strength of the egg albumen prior to pasteurization, 50% to 85% by weight of said so treated egg albumen being blended with at least 15% by weight of a whey protein-containing composition containing 35% to 80% by weight whey protein.

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**BLENDS OF EGG ALBUMEN AND WHEY PROTEIN EVIDENCING
IMPROVED GEL STRENGTH**

The present invention relates to dry blends of egg albumen and whey proteins which evidence improved gel strength and processes for preparing the same.

5 **Background of the Present Invention**

 Dried egg albumen is a well known commercial product. Albumen, after separation from yolk, is subjected to a desugaring step to avoid browning upon drying. Desugaring is generally accomplished by
10 treating egg albumen with bacteria such as Enterobacter Aerogenes which consume the glucose in the egg. The desugared egg albumen is then dried such as by pan drying or spray drying. The details are more fully set forth in the Science and Technology of Egg Products
15 Manufactured in the United States, Forsythe R. (1968) (publisher).

 Since it is well known that egg albumen is a perfect breeding ground for various bacteria including the highly toxic salmonella, the product
20 must be pasteurized before distribution and sale. One of the effective pasteurization means is termed "Hot Room Treatment". In this treatment the dried egg albumen in closed containers is placed in a clean sealed room, the containers being
25 spaced sufficiently to assure adequate heat penetration and air circulation. Spray dried albumen is heated throughout to a temperature of not less than 54°C (130°F) and held continuously at such

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temperature for not less than five days and until it is salmonella negative. Pan dried albumen is heated throughout to a temperature of not less than 52°C (125°F.) and held continuously at such temperature for not less than five days and until salmonella negative. This is set forth in the U.S. Department of Agriculture regulations governing the inspection of eggs and egg products (7 CFR 59.575). An average treatment time is two weeks.

10 Much experimental work has been conducted to determine the effect of this type of pasteurization on the content of salmonella and the functional properties of the egg albumen. In the article entitled "The Effect of High-Temperature Storage on the Content of Salmonella and on the Functional Properties of Dried Egg White" by G. J. Banwart and J. C. Ayres, Food Technology 10:68-73, it is indicated that albumen containing 1.5, 3 or 6% moisture stored for 150, 120 and 90 days respectively at 50°C. provided good salmonella control without any significant loss in the volume of angel cakes. Albumen with 12% moisture showed a significant decrease in the volume of resulting angel cakes when stored for three days. Of similar import are the papers entitled "High Temperature Storage of Spray-Dried Egg White", No. 1, Whipping Time and Quality of Angel Cake, by R. E. Baldwin et al., Poultry Science 46:1421-1430; "High Temperature Storage of Spray-Dried Egg White", No. 2, Electrophoretic Mobility, Conalbumen-Iron Complexing,

Sulfhydryl Activity, and Evolution of Volatile Bases,
by O. J. Cotterill, Poultry Science 46:1431-1437;
"Spray Drying of Egg White at Various pH Levels"
by W. M. Hill, Poultry Science 44:1155-1163 and
"High Temperature Storage of Spray-Dried Egg White"
5 by L. E. McBee et al., Poultry Science:50, No. 2
pages 452-458.

It is also well known to prepare various
products from whey, the by-product of cheese manu-
facture. The products that can be obtained from
10 whey include, among others, a whey protein concen-
trate. Whey protein concentrates can be made by
numerous methods including gel fractionation (U.S.
Re. 27,806) as well as by ultrafiltration. An
illustrative method for ultrafiltration is described
15 by Horton, B. S. et al., Food Technology, Volume 26,
page 30 (1972). Whey protein concentrate generally
has about 35% to about 80% protein. One of the proteins in
the whey protein concentrate is a water soluble
protein of the albumenoid class of proteins.
20 Because some of the protein in whey protein concentrate
is from the same class as that of egg albumen,
workers thought that one of the obvious areas of
use of this lower cost protein would be in extending
egg albumen. Various workers have attempted to
25 substitute whey protein concentrate for egg albumen
in various recipes. Depending on the functionality
for which the eggs were used, the richness in
eggs of the recipe and the type of whey protein
concentrate used, successes have been sporadic.

In attempting to make a hard-whipped meringue, whey protein concentrate from ultrafiltration is not entirely satisfactory. In general, the critical test for the substitution is the preparation of angel cake and it is not known whether or not any whey protein can be used as a substitute for egg albumen either alone or partially (around 50%). Various prior processes for preparing "egg white substitutes" are disclosed in the prior art discussion in U.S. Patent 4,089,987. In general, the replacements on a functional basis cannot be accomplished without the addition of secondary ingredients such as carboxymethylcellulose or the materials disclosed in 4,089,987. In the past blends of egg albumen and whey protein concentrate have been made in a recipe by partially replacing egg albumen. This is generally accomplished using either liquid or dried egg albumen and a whey protein concentrate.

One of the unique properties of egg albumen is its ability to form a stable gel at a relatively low temperature. A 15% solution of a desugared spray-dried egg albumen which has been hot room treated as standard in the industry will provide a gel by heating the solution to a temperature of about 70°C.

for about 30 minutes. It is also possible to gel a whey protein concentrate by heating a solution of 15% whey protein for 30 minutes at 85°C. Relative gel strengths for the respective

products are about 90 grams and 450 grams respectively as tested with a penetrometer. In attempting to provide blends of egg albumen and whey protein concentrate for use as gel forming material, it was discovered that the gels provided by the blends are weaker than that provided by the weakest component used alone. The same result is achieved when the whey protein concentrate is mixed with the egg and then hot room treated or if the whey protein concentrate is hot room treated prior to it mixing with the spray-dried egg white. In both cases the product would brown and be unacceptable. These findings severely limit the use of whey protein concentrate as a blend with egg albumen in areas where the gelling function of the egg albumen is of significance.

Brief Summary of the Invention

In accordance with the present invention, it has been found that the gel strength of blends of whey containing materials and dried egg albumen at temperatures below 85°C. in a 15% solution for 30 minutes can be improved by subjecting desugared dried pasteurized egg albumen to treatment in the hot room for a period of time ranging from above about two weeks to about eight weeks counting beyond the time the heat history of the egg albumen has been above about 55°C. This includes any pasteurization procedure in the hot room. Preferably, the hot room treatment is conducted for a period of time of about three to about six weeks and more preferably about five weeks \pm 0.5 week. This material when blended with the whey protein concentrate, provides a gel strength higher than the blend of the normal

pasteurized egg albumen and thus sufficiently high to be commercially useful in the area of blends of whey protein and egg albumen for functional gelation uses. Whey protein concentrate can be
5 prepared by various processes which include post treatments as will be explained more fully herein-after.

Detailed Description of the Present Invention

10 The present invention relates to dried blends of dried egg albumen and dried whey protein material. Any commercially available dried egg albumen is effectively usable in the present invention. Preferably, the dried egg albumen is prepared by the
15 standard process which includes desugaring of the egg albumen, pan or spray drying followed by a sufficient hot room treatment to effect salmonella control. Procedures for preparing this type of material are well known in the industry and have
20 been described hereinbefore.

In accordance with this invention, the dried egg albumen is required to be subjected to treatment under heat for a period of time ranging above about two weeks (at least 15 days) to about eight
25 weeks, the time including any heat treatment used for pasteurization. In general, the apparatus and conditions used for hot room treatment pasteurization are also effective in treatment of the egg albumen for purposes of the invention. The dried egg

albumen can be purchased commercially and then subjected to a heat treatment or the egg albumen can be subjected to a complete heat treatment for the entire period without a cool down period in
5 between. In either case, the egg albumen as obtained will effectively provide, when combined with the whey protein concentrate, a product of a gel strength superior to that of a blend of a whey protein concentrate and a pasteurized dried egg albumen without extended heat treatment.
10

The amount of heating depends on the time the dried product has been heated above 55°C. The heat history is not intended to include the heat needed for drying. Thus, the dry egg albumen can be heated
15 above 55°C. for the pasteurization period, cooled down and reheated or the dry egg albumen can be heated continuously for a period sufficient to pasteurize and heat treat in accordance with the invention. The heat treatment must be sufficiently
20 long at the temperature used to raise the gel strength above about 250 grams over the gel strength of the dried egg albumen prior to pasteurization. Higher temperatures provide higher gel strengths. In other words, equivalent gels strength can be reached in
25 shorter time using higher temperature than using lower temperature and longer time. It is preferred that the heating temperatures range from about 55°C. to about 65°C. Extended heating (beyond eight weeks) has not been found to provide any beneficial results.

The whey protein-containing composition for use in the present invention preferably contains from about 35% to about 80% dairy derived protein on a dry solids basis. Of that dairy derived protein, at least 50%, preferably at least 75%, more preferably at least 90% and most preferably 100% of the protein is whey protein. The whey protein is generally provided by a whey protein concentrate (at least 35% protein). On a solids basis, the whey protein-containing composition is preferably comprised of at least 50% and preferably from about 75% to about 100% of a whey protein concentrate having at least 35% protein, from 50% to about 0% and preferably from 25% to about 0% of another dairy protein-containing composition including other whey protein-containing compositions.

The whey protein concentrate as well as other whey protein-containing products used in the present invention can be derived from cheese whey, casein whey and soy whey and preferably cheese whey. Cheese whey is the by-product of the acid or rennet coagulation of protein (casein) from milk.

Sweet whey or cheddar whey is obtained by the separation and removal of coagulated casein produced by the addition of a proteolytic enzyme to milk. The proteolytic enzymes generally used are known as rennin and/or pepsin. Specific examples of cheese products produced by this method include cheddar cheese, swiss cheese and mozzarella.

Acid or cottage cheese whey is the by-product obtained from the acid coagulation of milk protein by the use of lactic acid producing bacteria (e.g., lactobacillus) or by the addition of food grade acids such as lactic or hydrochloric acid, i.e., direct acidification. In either case, acidification is allowed to proceed until a pH of approximately 4.6 is reached. At this pH, casein becomes insolubilized and coagulates as cheese curd.

The whey protein concentrate as used in the invention can be derived from 100% acid cheese whey though minor amounts of other cheese wheys of less than 50% and preferably less than 20% can be utilized. Such other cheese wheys include but are not limited to cheddar cheese whey.

The whey protein concentrate used in the invention can be prepared by any one of a number of known processes including electrodialysis (Stribley, R. C., Food Processing, Volume 24, No. 1, page 49, 1963), reverse osmosis, (Marshall, P. G. et al., Fractionation and Concentration of Whey by Reverse Osmosis, Food Technology, 22(a), 696, 1968), gel filtration (U.S. Pat. No. Re. 27,806); or by ultrafiltration

(Horton, B.S. et al., Food Technology, Volume 26, page 30, 1972). Chemical methods including the phosphate precipitation of whey protein can also be used as described in Gordon U. S. Patent No.

- 5 2,388,624 and Melachouris U.S. Patent No. 4,043,990. Products such as lactalbumen phosphate are also to be considered whey protein concentrates. The whey protein concentrate should contain at least 35% protein based on total Kjeldahl nitrogen.

- 10 For example, an ultrafiltered acid (cottage cheese) whey concentrate containing from about 40% to about 60% and preferably about 45% to about 55% whey protein can be used in the invention. In a typical process, cottage cheese whey is neutralized to a pH of
15 about 6.4 with 50% caustic. After storage, the pH is then adjusted to about 7.2 and any solids or precipitates are removed by centrifugal clarifiers. The clarified liquor is then pasteurized. The liquor is then fed into an ultrafiltration membrane
20 unit. The retentate is condensed and spray dried. Protein products containing 35% or more whey protein can be prepared by this process. Products generally comprising from about 40% to about 60% protein (TKN x 6.38), 10-30% lactose, 3-15% ash, and 0.1-4%
25 fat are obtained. The dried retentate with the aforegiven composition is considered a whey protein concentrate. While it is preferred to use the whey protein concentrate in the dry form, the liquid form can also be used on a percent by weight solids

basis, when blending of the whey protein concentrate and the dry heat treated albumen is accomplished during the formulation of the final product in which the blend is used. Liquid levels in the final formulation
5 are adjusted to the correct solid/liquid ratio. Liquid whey protein concentrate must be kept under refrigeration to prevent spoilage.

The whey protein concentrate can also be combined with another protein-containing whey based
10 product such as dried whey, delactosed whey, delactosed/demineralized whey where demineralization is accomplished by any known method such as electrodialysis, ion exchange or material transfer (ultrafiltration, reverse osmosis), as well as the dried mother liquor (clarified
15 whey) remaining after separation of the precipitates prepared in accordance with United States patents Nos. 3,560,219 and 4,036,999.

Other non-whey based dairy protein compositions which can be used include milk and milk solids, e.g.
20 NFDM, casein and caseinates including sodium, potassium and calcium caseinate.

The whey protein concentrate can also be post treated after separation to vary the properties of the composition. Specifically, the thermal gellation
25 temperature of the whey protein concentrate can be reduced by an alkaline heat treatment. In this process a whey protein concentrate has its pH elevated to within the range of 8 to 10 and preferably around 9 to 9.5 and is heated within the range of from
30 about 70°C. to about 77.5°C. preferably from about

72.5 to about 75°C. and immediately cooled down such that the heating is maintained for no longer than about 60 and preferably 15 seconds. The pH can be adjusted down to neutral as desired.

5 The strength of the gels prepared with the blends depends on the quantity of egg albumen replaced. As the quantity of egg albumen in the blend decreases so does the strength of the gels provided. Effective results have been found utilizing from about 50%
10 to about 85% egg albumen and conversely at least about 15% whey protein concentrate and preferably from about 50% to about 15% whey protein concentrate with about 75% egg albumen and about 25% whey protein concentrate being more preferred.

15 The blends of the present invention can be made by dry blending the ingredients and selling the blend. If the blend is to be used as part of a dry mix for preparing a food, the blending can be accomplished during preparation of the mix. The
20 two separate components of the blend can also be added during the preparation of the food in which the blend is to be used. Blending can be conducted on the dry materials or reliquified materials. Only the egg albumen must be processed to a dry stage
25 at some time during its processing history.

The products of the present invention can be used in any area where the gellation properties of egg albumen are significant. These include binding comminuted meat and fish.

- 5 It is to be noted that the process of the present invention is particularly significant in providing effective gels at the lowest possible gellation temperatures to save on energy costs as well as not consuming excess time. The higher the gellation
- 10 temperature used in preparing the gels the less distinction is seen between compositions.

The invention will be more fully illustrated in the examples which follow.

EXAMPLE 1

Commercially available desugared dried egg albumen which had received two weeks of heat treatment at 60°C. was subjected to additional heat treatment for various periods of time. A 2.25 kilo package of commercial pasteurized dried egg albumen was placed in an oven at 55°C. Samples were removed from the box at various periods of time. The gel strength of blends of 75% egg albumen and 25% whey protein concentrate which had been heated in a 16.5% solution at a pH of 8.7 to a temperature of 75.5°C. for 16 seconds, cooled and neutralized were determined. Gel conditions are given in table, heating time was thirty minutes. The gelation test involved dissolving the test protein in an appropriate quantity of water to obtain the desired percent total solids or percent total protein. The product of the invention and the control were tested in solutions containing 10-15% total solids and about 7-10% protein. The pH of the solution was adjusted to 7.0 with a minimum amount of acid (HCl) or base (NaOH). Thirty-five grams of solution was weighed into a 35 cm x 45 cm diameter glass dish. The dish was covered with plastic film and a watch glass. The glass dish was lowered into a hot water bath for thirty minutes, from the time the dish was placed into the bath. After thirty minutes, the dish was placed in a refrigerator immediately after heating and held overnight. The gel strength is determined by allowing the temperature of the gel to reach room temperature (25°C., a water bath can be used for this purpose) and then inverting the gel on the scale of a Marine Colloids gel tester

(slow speed and small plunger). The amount of force in grams required to break the center of the gel is then determined. The results are shown in the following table:

5

TABLE 1

	<u>Extra Storage Time</u>	<u>Gel Strength-grams</u>	
		<u>70°C/15%T.S.</u>	<u>90°C/10%T.S.</u>
	0 weeks	20	120
10	1	128	135
	2	125	145
	3	243	185
	4	240	200
	5	245	220
15	Commercial Egg	90	180
	Albumen alone*		
	Whey Protein	163	-
	Concentrate* alone		

20 * Experiments run at different times than experiments providing the main data for the Table.

As can be seen from the data, a blend of commercial dried egg albumen pasteurized for two weeks in a hot room and whey protein concentrate provided gel strength at 70°C. of 20 whereas commercial
 25 pasteurized egg albumen alone provided a gel strength of 90 and whey protein concentrate a gel strength of 163. Blends of commercial dried egg albumen and whey protein concentrate provide gel strengths lower than
 30 either ingredient alone. By the process of the invention, it is possible to provide blends which equal and even surpass the gel strength of the component providing the greatest gel strength.

EXAMPLE 2

Various whey protein concentrates were used with various lots of commercially heat treated desugared dried egg albumen. Heat treatment of the egg albumen was conducted under plant conditions of 60°C. for a total of four or five weeks (2-3 weeks extra). The following results were obtained using a 75% dried egg albumen, 25% whey protein concentrate blend:

TABLE 2

Gel Strength of Blend of WPC and Egg Albumen
with 5 Weeks of Heat Treatment

Egg Albumen Lot	Gel Strength, gm.		
	15%, 70°C. (As is)	15%, 70°C. (75:25) WAPRO 50*	10%, 90°C. (75:25) WAPRO 50*
1	218	158	130
2	239	168	120
3	265	193	160
4	238	170	120
5	261	175	140
(75:25) ENRPRO LGT**			
5	261	120	160
(75:25) ENRPRO 50***			
5	261	110	155

TABLE 3

Gel Strength of Blend of WPC and Egg Albumen
with 5 Weeks of Heat Treatment

5	Egg Albumen Lot	Gel Strength, gm.		
		15%, 70°C. (As is)	15%, 70°C. (75:25) WAPRO 50*	10%, 90°C. (75:25) WAPRO 50*
	6	295	210	160
	7	280	190	155
	8	330	210	173
10	9	305	195	163
			(75:25) ENRPRO LGT**	
	9	305	170	235
15			(75:25) ENRPRO 50***	
	9	305	170	235

20. Footnotes for Tables .2 and 3

Gel strength of commercial pasteurized (2 weeks)
desugared dried egg albumen: 95 gm. (70°C.), 160 gm.
(90°C.)

* Ultrafiltered sweet whey

25 ** Ultrafiltered acid whey heated to 75.5°C. at pH 8.7
for 16 seconds, cooled, and neutralized.

*** Ultrafiltered acid whey

EXAMPLE 3

5 Blends of 75% commercially available egg albumen heat treated for an additional five weeks as outlined in the preceding example and 25% of various whey protein concentrate products were prepared with the following results:

TABLE 4

	<u>Whey Protein Concentrate</u>	<u>% Protein</u>	<u>Gel Strength-grams 70°C/15% T.S.</u>
	ENRPRO 50	50	235
	ENRPRO LGT		
	Lot 1	50	245
15	Lot 2	50	315
	Wapro 50	50	340
	Wapro 35	35	240
	Foretein 35	35	255
	Na-Protolac	55-60	265
	Amberpro	65	245
	Lacto Albumen	73	400
	Lacto Albumen	71	285
20	Hi Sorb Conc	-	335
	Na Caseinate	90	335
	N.F.D.M.	35	300
	Solac Spec 80	80	430

TABLE 5

PROTEIN IDENTIFICATION TABLE *

	1. ENRPRO	Ultrafiltered WPC - 50%
	2. ENRPRO LGT	See Footnote **, Table Y
5	3. Wapro 50	Ultrafiltered WPC - 50% WP
	4. Wapro 35	Ultrafiltered WPC - 35% WP
	5. Foretein 35	Electrodialyzed Whey - 35% WP
	6. Na Protolac	Phosphate precipitated protein - 55-60% WP
10	7. Amberpro	Heat denatured Ultrafiltered WPC
	8. Lacto Albumen	New Zealand
	9. Lacto Albumen	West Germany
	10. High Sorb Conc.	Partially delactosed Skim Milk
	11. Na Caseinate	
15	12. N.F.D.M.	
	13. Solac Spec 80	Ultrafiltered WPC

* WPC - Whey Protein Concentrate

WP - Whey Protein

EXAMPLE 4

5 A sample of a whey protein concentrate obtained by concentrating the whey protein of an acid whey by ultrafiltration was stored in an oven in a plastic bag for various periods of time at 55°C. Samples were removed and color changes noted as follows:

TABLE 6

10	<u>Time - Days</u>	<u>Color</u>	<u>Gel Strength-grams</u> <u>15% T.S./85°C./30 min.</u>
	0	sl. off white	435
	10	light brown	5
	14	medium brown	No gel - sample insoluble
15	35	dark brown	" " " "

Hot room treatment is harmful to whey protein concentrate as the product browns, becomes insoluble.

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CLAIMS

1. A process for preparing a dried blend of a pasteurized egg albumen and whey protein-containing composition which exhibits improved gel strength, comprising the steps of

(1) subjecting desugared, dried pasteurized egg albumen to a heat treatment at a temperature of about 55°C to about 65°C for a period of time which is about two weeks to about eight weeks more than the time for which the egg albumen was subjected to dry pasteurization at above about 55°C, said period of time being sufficient to elevate the gel strength of the egg albumen to more than 250 grams in excess of the gel strength of the egg albumen prior to pasteurization, and (2) blending about 50% to about 85% by weight of said so treated egg albumen with at least 15% of a whey protein-containing composition having from about 35% to about 80% by weight whey protein.

2. A process according to claim 1 wherein said period of heat treatment time is about three weeks to about six weeks.

3. A process according to claim 1 or 2 wherein said egg albumen is heat treated for about five weeks \pm 0.5 week.

4. A process according to any one of the preceding claims wherein said whey protein composition is a concentrate prepared by ultrafiltration.

5. A process according to any one of the preceding claims wherein the weight ratio of heat treated egg albumen to whey protein composition is about 75:25 to about 50:50.

6. A dried blend of pasteurized egg albumen and a whey protein-containing composition exhibiting improved gel strength, said dried blend comprising about

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50% to about 85% of a desugared, dry pasteurized egg albumen which has been heat treated at a temperature of about 55°C to about 65°C for a period which is about two weeks to about eight weeks more than the time of dry pasteurization of the dry egg albumen above about 60°C, in combination with a whey protein-containing composition comprising:

(1) about 50% to 100% by weight of a whey protein concentrate derived by ultrafiltration of whey, said concentrate having about 40% to about 60% protein, and

(2) from about 50% to 0% of another dairy-protein-containing product which is milk, milk solids, casein, sodium caseinate, potassium caseinate or calcium caseinate.

7. A composition according to claim 6 wherein the pasteurized heat treated egg albumen is present in an amount of about 75% to about 50% by weight and the whey protein-containing composition is present in an amount of about 25% to about 50% by weight based on the combined weight of albumen and whey protein-containing composition.

8. A composition according to claim 6 or 7 wherein the heat treatment time period is about three weeks to about six weeks.

9. A composition according to any one of claims 6 to 8 wherein the whey protein-containing composition is a whey protein concentrate.

10. A composition according to any one of claims 6 to 9 wherein said pasteurized egg albumen was heat treated for about five weeks \pm 0.5 week at a temperature of about 55°C to about 65°C.

11. A composition according to any one of claims 6 to 10 wherein the amount of egg albumen is about 75% and the whey protein-containing composition is a whey protein concentrate.



European Patent
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EUROPEAN SEARCH REPORT

0102416

Application number

EP 82 30 4445

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
A	BE-A- 843 067 (Q.P.CORPORATION) *Claims 1,3; page 5, paragraph 1*	1,2,3	A 23 J 3/00
A	FR-A- 489 303 (M.D.M.VAN DER HAGEN) *Abstract; column 1, last paragraph; column 2, paragraph 1,2*	1	
A	GB-A-2 010 066 (STAUFFER) *Claims 1,2; page 2, lines 13-17; page 4, table I, example 2A*	1,4,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
			A 23 J A 23 B A 23 L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28-04-1983	Examiner PEETERS J.C.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			